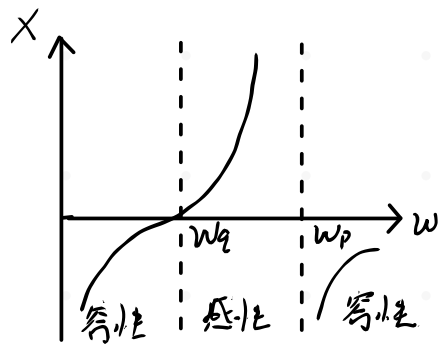
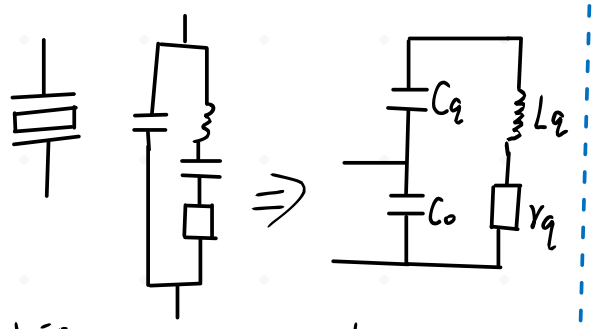


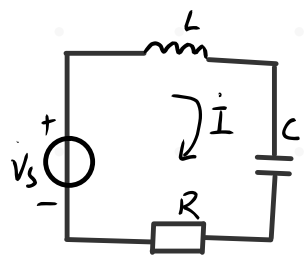


串联谐振频率 $\omega_q = \frac{1}{\sqrt{L_q C_q}}$

并联谐振频率 $\omega_p = \frac{1}{\sqrt{L_q \frac{C_0 C_q}{C_0 + C_q}}}$

$P = \frac{C_q}{C_0}$ 很小，

$\omega_p > \omega_q$ 但很接近



串联谐振回路

① 回路阻抗 $Z = R + j(\omega L - \frac{1}{\omega C})$（电阻 ↑ 电抗 ↑）

谐振时的感抗/容抗 —— 特性阻抗 $\rho = \omega_0 L = \frac{1}{\omega_0 C} = \sqrt{\frac{L}{C}}$

② 谐振频率 $\omega_0 = \frac{1}{\sqrt{LC}}$

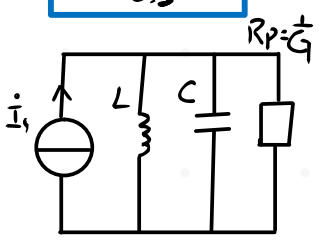
③ 品质因数 $Q = \frac{\omega_0 L}{R} = \frac{1}{\omega_0 C R} = \frac{\rho}{R} = \frac{1}{R}\sqrt{\frac{L}{C}}$

④ 广义失谐系数 $\xi = \frac{\text{失谐电抗}}{\text{谐振电阻}} = \frac{X}{R} = Q_0(\frac{\omega}{\omega_0} - \frac{\omega_0}{\omega})$

$\omega \approx \omega_0$ 时 $\xi \approx Q_0 \frac{2\Delta\omega}{\omega_0} = Q_0 \frac{2\Delta f}{f_0}$

⑤ 谐振曲线 $N(f) = \frac{\text{失谐电流}}{\text{谐振电流}} = \frac{1}{1+j\xi}$

⑥ 通频带 $B = 2\Delta f_{0.7} = \frac{f_0}{Q_0}$



并联谐振回路

① 回路导纳 $Y = \frac{RC}{L} + j(\omega C - \frac{1}{\omega L}) = G + jB$（电导 G ↑ 电纳 B ↑）

② 谐振频率 $\omega_p = \frac{1}{\sqrt{LC}}$

③ 品质因数 $Q = \frac{\omega_p L}{R} = \frac{R_P}{\omega_p L} = \frac{R_P}{\rho} = R_P\sqrt{\frac{C}{L}}$

④ 广义失谐系数 $\xi = \frac{\text{失谐电纳}}{\text{谐振电导}} = Q_P(\frac{\omega}{\omega_p} - \frac{\omega_p}{\omega})$

$\omega \approx \omega_0$ 时 $\xi \approx Q_P \frac{2\Delta\omega}{\omega_p} = Q_0 \frac{2\Delta f}{f_p}$

⑤ 谐振曲线 $N(f) = \frac{\text{失谐电压}}{\text{谐振电压}} = \frac{1}{1+j\xi}$

⑥ 通频带 $B = 2\Delta f_{0.7} = \frac{f_p}{Q_P}$

通信电子线路分析基础

非线性电路分析基础

分析方法：幂级数法；折线法；线性时变参量法

选频网络

谐振回路

单振荡回路

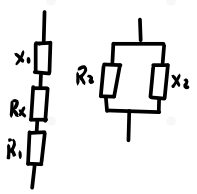
串联谐振回路

并联谐振回路

耦合振荡回路

阻抗变换

串并联



$R_2 = (1+D_L)^2(R_1 + R_x) \approx (R_1 + R_x)D_L^2$

$X_2 = (1+D_L^2)X_1 \approx X_1$

抽头

低抽头→高抽头

阻抗提升 D_L 倍

电压提高 D_L 倍

电流降低 D_L 倍

插入损耗 $K = \left(\frac{1}{1-D_L}\right)^2$

耦合回路

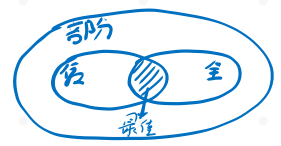
未耦合谐振

部分谐振 $X_{11} + X_{f1} = 0$

欠谐振 $X_{11} + X_{f1} = 0$ 且 $R_{11} = R_{f1}$

全谐振 $X_{11} = 0$ $X_{22} = 0$

（若再 $R_{11} = R_{f1}$ $R_{22} = R_{f2}$ → 最佳全谐振）



反射阻抗 $Z_{f1} = \frac{(\omega M)^2}{Z_{22}} \rightarrow R_{f1} = \frac{(\omega M)^2}{R_{22}^2 + X_{22}^2} R_{22}$ $X_{f1} = \frac{-(\omega M)^2}{R_{22}^2 + X_{22}^2} X_{22}$

$Z_{f2} = \frac{(\omega M)^2}{Z_{11}} \rightarrow R_{f2} = \frac{(\omega M)^2}{R_{11}^2 + X_{11}^2} R_{11}$ $X_{f2} = \frac{-(\omega M)^2}{R_{11}^2 + X_{11}^2} X_{22}$

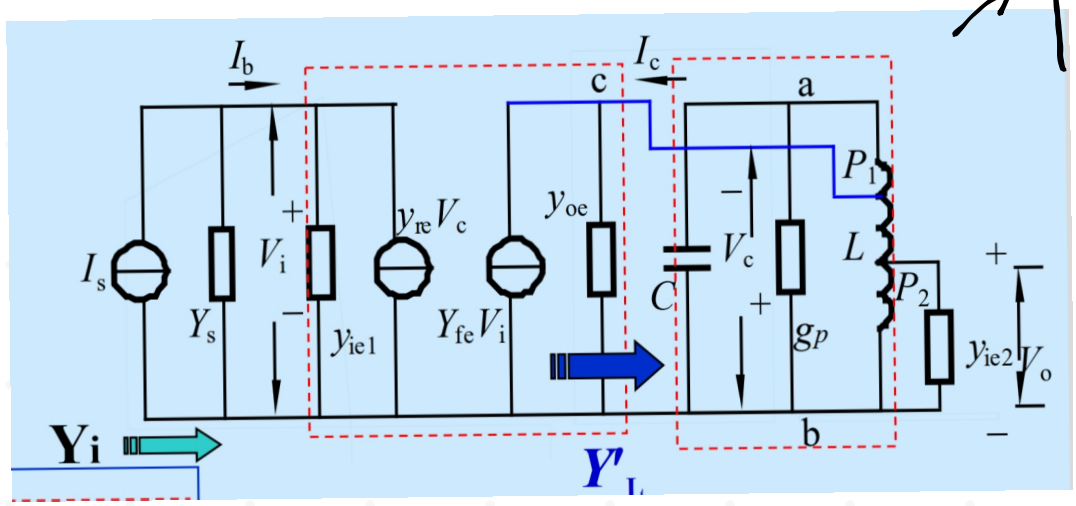
耦合因数 η：<1 弱耦合；$=1$ 临界耦合；>1 强耦合

耦合回路通频带 $2\Delta f_{0.7} = \sqrt{\eta^2 + 1} \cdot \frac{f_0}{Q_0}$

$$C_\Sigma = P_1^2 C_{oe} + P_2^2 C_{ie} + C$$
$$g_\Sigma = P_1^2 g_{oe} + P_2^2 g_{ie} + g_p$$

$$A_{V0} = \frac{P_1 P_2 |y_{fe}|}{g_\Sigma}$$
$$\dot{A}_V = \frac{P_1 P_2 |y_{fe}|}{g_\Sigma + j\omega C_\Sigma + \frac{1}{j\omega L}}$$

$$Q_p = \frac{\omega_p C_\Sigma}{g_p}$$
$$Q_L = \frac{\omega_p C_\Sigma}{g_\Sigma}$$



$$\begin{cases} Y_L = g_p + j\omega C + \frac{1}{j\omega C} + \frac{1}{j\omega L} + P_2^2 y_{ie2} \\ Y_L' = \frac{1}{P_1^2}\left(g_p + j\omega C + \frac{1}{j\omega L} + P_2^2 y_{ie2}\right) \end{cases}$$

高频谐振小信号放大器

增益

单级

多级

$A_V = A_{V1} A_{V2} \cdots A_{Vm}$

$$\frac{A_V}{A_{V0}} = \frac{1}{\sqrt{1+\left(\frac{Q_L}{f_p} 2\Delta f\right)^2}}$$
$$\frac{A_m}{A_{m0}} = \left[\frac{1}{\sqrt{1+\left(\frac{Q_L}{f_p} 2\Delta f\right)^2}}\right]^m$$

矛盾

工作稳定性

y_{re} 的存在会导致自激

中和、失配

稳定系数

$$S = \frac{2(g_s + g_{ie})(g_{oe} + g_L)}{|y_{fe}||y_{re}|[1+\cos(\varphi_{oe}+\varphi_{fe})]}$$

$S=5$ 时

$$(A_{V0})_S = \sqrt{\frac{|y_{fe}|}{2.5\,\omega_0 C_{re}}}$$

通频带

$$B = \frac{f_p}{Q_L}$$

$$B_m = \sqrt{2^{\frac{1}{m}}-1}\,\frac{f_p}{Q_L}$$

$$A_{V0} \cdot B = \frac{P_1 P_2 |y_{fe}|}{2\pi C_\Sigma}$$

带宽增益积为常数

矛盾

选择性

矩形系数

$$K_{r0.1} = \frac{2\Delta f_{0.1}}{2\Delta f_{0.7}}$$

$$K_{r0.01} = \frac{2\Delta f_{0.01}}{2\Delta f_{0.7}}$$

K_r 越 $\to 1$，选择性越好

抑制比

$d_n = \frac{A_{V0}}{A_n}$ → 消振点 f_0 放大倍数 / 干扰信号的放大倍数

噪声系数

$$N_F = \frac{P_{Si}/P_{ni}}{P_{So}/P_{no}}$$

P_{Si}/P_{ni} → 输入信噪比

P_{So}/P_{no} → 输出信噪比

N_F 越接近 1 越好